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Beyond Gridlock:

The Case for Greater Integration of Regional Electricity Markets

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In this issue...

How best to avoid power blackouts, brownouts and rising electricity costs? Further integration of neighbouring electricity markets holds some of the answers to these and other power dilemmas.

The Study in Brief

The degree of integration of electricity markets, both within Canada and between Canadian and US markets, is a contentious issue for politicians and public policymakers. There is little public consensus, for example, on whether integration increases vulnerability to power disruptions, or reduces it. With the growth in electricity consumption in Canada outpacing the growth in generating capacity, the time is right for a clear analysis of these issues. This paper presents the case for greater integration, based on the lessons of trade theory and the current realities of electricity markets.

More trade in electricity — or better regional market integration — would be good for Canadian consumers. More trade across provincial, state and national borders would drive better productivity performance by electricity producers and transmitters and yield an array of benefits.

Benefits include: reducing the total costs of electricity; improving the efficiency with which generating and transmission resources are used; reducing consumers' costs; reducing price volatility; and mitigating market power by dominant players. More integration would also increase competition, improve reliability, create better incentives for making optimal investments in generating and transmission assets, and reduce the adverse environmental effects of generating and transmitting electricity. In contrast, the downsides to better market integration are few, and are susceptible to effective mitigation or avoidable through careful market design.

After examining the benefits of greater market integration, the study sets out seven preconditions for success in regional market integration. It then assesses the degree to which they exist in Canada and Ontario.

This *Commentary* concludes that Canada can enhance the performance of its electricity market by increasing the size of its market and by increasing the degree of integration, both within the Canadian market and with the adjacent, electrically interconnected United States market. Because of the geographic and demographic characteristics of North America, increased north-south integration is at least as promising as increased east-west integration.

Within Canada, the National Energy Board should take a much more active role in the business of increasing the degree of regional integration within the Canadian electricity market.

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Electricity markets are an anomaly in a world where many energy markets are global or at least continental. Oil is traded at a single price in world markets; natural gas is traded at single prices in continental and increasingly global markets. Other commodities like wheat, nickel, copper and steel are traded on international markets. With respect to manufactured goods, such as automobiles, computers, footwear and clothing, post-war trade liberalization has meant that markets for most of these goods are increasingly international. The reason: international markets enable producers to exploit their comparative advantage; increase returns to scale, specialization and hence productivity; and increase consumer welfare by increasing choices and reducing costs and prices (Trebilcock and Howse 2005). In contrast, many electricity markets have historically been largely local in nature and have entailed very limited trading of electricity across jurisdictions within federal states or across national borders. This paper explores why this has been so and makes the case for greater regional integration of electricity markets in the future.

In Part I, we discuss the effects of greater regional integration of electricity markets. We conclude that greater integration has the potential to improve the performance of electricity markets in many ways. The expected benefits include: reducing the total costs of electricity; improving the efficiency with which generating and transmission resources are used; reducing consumers' costs; reducing price volatility; and mitigating market power by dominant players. Further integration would also increase competition, improve reliability, create better incentives for making optimal investments in generating and transmission assets, and reduce the adverse environmental effects of generating and transmitting electricity. We also identify and discuss several potential, or perceived, adverse effects of increased integration. We conclude that each one is non-existent, exaggerated, susceptible to effective mitigation, or avoidable through careful market design.

In Part II, we present a diagnostic tool-kit for assessing electricity markets in diverse jurisdictions. We identify and discuss seven preconditions for success in designing and implementing a large regional market. They are: (i) vertical separation of functions (between generation and sales on one hand, and transmission and distribution on the other); (ii) horizontal integration (of transmission and network operations, and reliability standards); (iii) non-discriminatory access to the transmission grid; (iv) an effectively functioning spot market; (v) consumer incentives to respond to price changes; (vi) a mechanism for allocating scarce transmission capacity; and (vii) mechanisms that induce or require adequate investment in transmission capacity.

In Part III, we provide an overview of the present electricity market in Canada, and analyze the situation in Ontario, with reference to the seven preconditions for the creation of an efficiently functioning regional electricity market. We conclude that Canada can enhance the performance of its electricity market by increasing the size of the market and increasing the degree of integration, both within the Canadian market and with the adjacent, electrically interconnected United States market. Because of the geographic and demographic characteristics of North

We are indebted to Andrew Barrett, Alex Henney, Roy Hrab, Larry Ruff, and Peter Sergejewich for helpful comments on an earlier draft.

America, we conclude that increased north-south integration is more promising than increased east-west integration. Within Canada, we urge the National Energy Board to begin to take a much more active role in the process of increasing the degree of regional integration of the Canadian electricity market.

Part I: The Benefits of Greater Market Integration

A market is integrated in an economic sense if the prices at each location in the market differ only by the cost of transactions between the various locations.[1] In an integrated market for electricity, the difference in the price of electricity in one physical location should only differ from that in another by the cost of transmitting electricity between those two locations. An obvious requirement for economic integration of markets is the physical interconnection of the regions in which those markets exist.

Even if regions are interconnected, however, transmission costs, congestion costs, transaction costs and the exercise of market power by a dominant firm may cause differences in the prices observed. Transmission costs are due to line losses (losses due to electrical resistance) and can be significant when electricity is transmitted over long distances. Congestion costs occur when there is no available capacity on the interconnection between regions, in which case the prices in each regional market will be determined separately.[2] The difference in prices in the markets reflects the opportunity cost of congestion; that is, the lack of available transmission capacity. Even in the absence of transmission congestion, however, prices in interconnected regions may diverge due to economic factors such as the exercise of market power and transaction costs for importing and exporting electricity.

The purpose of greater market integration is therefore to reduce or eliminate the physical and economic factors that prevent prices in interconnected regional markets from converging and accurately reflecting the true marginal cost of generation — the added cost for added generation — within the integrated markets. Besides affecting prices, however, integration can also have significant effects on costs, competition, reliability, investment, consumption, the environment and health, and the scope for government policy. We consider the impact of greater integration below.

Reduced Costs

Greater market integration can reduce the total cost of electricity by reducing transaction costs, reducing certain operational costs and increasing the optimal use

1 This is best understood in financial markets, where arbitrage between markets enforces the so-called "law of one price."

2 This applies in more conventional markets as well. If a good can be freely exported from one region to another, then the price in the importing region should only differ from the price in the exporting region by the cost of transportation. However, if there is a shortage of transportation capacity, then not enough of the good can reach the importing region. The result is that the markets will clear separately and the price in the importing region will be higher than the price in the exporting region.

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of generation and transmission resources. First, electricity market integration may reduce the transaction costs of importing and exporting electricity. Transaction costs — that is, the costs that electricity traders must bear in order to import and export electricity — prevent complete integration, as traders will only engage in such trade as long as expected profits from trading electricity are greater than the transaction costs.[3] If transaction costs are reduced, either by merging markets entirely or reducing the differences between market interfaces and rules, more trade can take place, increasing the gains from trade and driving prices in different locations closer together.

Second, greater integration can also reduce operational costs incurred by system operators and market participants who generally pass these costs on to the consumers of electricity.

In order to preserve the stability of a control area, a *system operator* usually schedules all imports and exports to and from the area in advance of when the actual power flows will occur.[4] Imports and exports must therefore be treated differently from other types of transactions in real-time markets for electricity, and the system operator must incur costs in scheduling the transaction from one control area to another. Furthermore, once flows are scheduled across an interconnection, they cannot be adjusted in real-time.[5] The *transmission operator* must therefore reserve some capacity on interconnections to account for unscheduled flows, which implies that there may be times when interconnections are not used most efficiently (Hunt 2002). By improving the coordination between system, market and transmission operators in different regions, greater integration can reduce the operational costs associated with the import and export of electricity.

Third, greater market integration can permit generation resources within a larger region to be used more efficiently. As demand for electricity varies greatly depending on, among other factors, the weather, the time of day and the season, system operators must have sufficient generation capacity available at all times to satisfy load during peak periods. System operators must also be able to adjust the total amount of generation output as load changes second by second. These constraints require a mix of generation technologies in an electricity system, each with different technical attributes and economic costs. Greater market integration provides system operators with a wider array of generation resources to draw on in order to match generation against load, increasing efficiency. Similarly, regions that have different load patterns can share capacity that would otherwise go unused during peak periods.

There is evidence that the cost savings from greater market integration can be substantial. A recent study (Hunt 2005) showed that the elimination of "seams"

3 These costs may include the costs of trading electricity between markets with different rules, systems and schedules and the cost of purchasing transmission capacity on interconnections between the markets.

4 The North American electricity grid is divided into control areas. For each control area, a system operator is responsible for ensuring that load (electricity demand) and generation (electricity supply) are balanced on a real-time basis.

5 This is true under normal circumstances. During emergencies or other system problems, scheduled power flows may have to be adjusted in order to maintain system stability.

among and between three control areas in the Pennsylvania/New Jersey/Maryland (PJM) electricity market in 2004 resulted in savings of approximately US$29.5 million for PJM and $36.4 million for the Eastern Interconnection. On an annualized basis, the savings for PJM and the Eastern Interconnection were $69.8 million and $85.4 million, respectively. Reduction in costs due to greater integration can have a significant impact on prices. PJM found that, after adjusting for rising fuel costs, prices in the PJM market declined by 4.2 percent between 2003 and 2004.

Reduced Price Volatility

Greater market integration can reduce the volatility of wholesale electricity prices, which is a significant risk for consumers, who may be unable to adjust their consumption in response to price spikes. Price volatility may also be a political concern where retail prices are tied to wholesale prices, as high volatility will periodically result in high prices. By increasing the available capacity in the market and by making the supply more responsive to price changes, greater market integration can reduce the volatility of electricity prices. This would reduce consumers' costs of managing price risk and potentially make deregulated electricity markets more politically acceptable.

Some critics of electricity market integration have argued that greater integration of electricity markets will necessarily disadvantage those regions with historically lower electricity prices (Cohen 2003). Greater integration, it is said, will result in increased exports to higher-priced regions, raising prices for consumers in lower-priced regions. This claim ignores one of the basic lessons of trade theory; namely, the gains from specialization and exchange. Where a region has a comparative advantage in the generation of electricity (i.e., it can generate electricity at lower cost), it is in its interest to trade that electricity (as with oil and gas) with other regions (Boyer, 2005). While electricity prices may rise in a region following greater integration, it is not the case that the region is economically disadvantaged. As trade theory tells us, regions that trade with other regions gain more than they lose, though it is important to note that one group within the region may receive the gains while another bears the costs.

More specifically, those critics making this argument usually emphasize the distributive effect of greater market integration by noting that consumers bear higher prices while generators earn greater profits. This concern is misdirected, however, as other policies exist to redistribute wealth in such cases. Moreover, unless a region has a comparative advantage in the generation of electricity (due to the availability of resources such as rivers, coal or natural gas), the only way for a region to keep its electricity prices lower than those in other regions is to make socially excessive investments in generation. However, this implies that taxpayers, not private investors, will bear the costs of these investments. Thus, consumers may not, in fact, be better off in the long run without greater market integration; they may be able to avoid higher electricity prices, but they will still bear the cost in the form of higher taxes.

This is not to say that individual consumer interests should be disregarded. As electricity consumption by individual consumers likely does not increase in a

constant proportion to income, lower-income individuals pay a higher percentage of their income for electricity than do higher-income individuals. Thus, an increase in electricity prices resulting from greater market integration would be regressive. This is a legitimate concern, but a more efficient and equally effective solution may be to provide rebates on energy expenditures to low-income energy consumers.

A variation of the above criticism is that higher prices will affect the production costs for industrial consumers of electricity, making them less competitive in global markets and reducing output and employment (Cohen 2002). As discussed above, proponents of this argument are essentially arguing for socially excessive investments in generation to support electricity-intensive industries. If promoting growth is the objective, rather than promoting particular industrial interests, then greater market integration achieves this objective regardless of whether prices would rise or fall as a result.

In short, the effects of greater integration of regional electricity markets are largely the same as the effects of liberalization in the trade of other goods and services. Generally, just as a region is better off by exporting goods in which it has a comparative advantage in production, and importing goods in which it does not, a region can be better off by integrating its market for electricity with those of other regions. This prescription applies whether or not a region has a comparative advantage in generation.

Increased Competition

Greater market integration may mitigate market power and increase competition in electricity markets. Electricity markets are particularly susceptible to the exercise of market power for a number of reasons: the high cost of storing electricity, the price inelasticity of short-run electricity demand, the large sunk costs required to enter the generation market, and the inelasticity of short-run electricity supply when load approaches capacity.[6] As a result, generators may have an incentive to withhold electricity from the market, particularly during peak periods (Wolfram 1999).

The exercise of market power raises concerns from both efficiency and distributive perspectives. First, by withholding capacity in order to increase the market price, a generator creates deadweight loss in the economy as consumers are priced out of the market. Second, because the exercise of market power raises the price of every megawatt exchanged in the market, wealth is effectively transferred from those who continue to consume electricity to those who produce it. Whether this redistribution is problematic, however, is a matter of controversy.[7] Even so, it is clear that the exercise of market power in electricity markets is undesirable from society's perspective due to the inefficiencies it creates.

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6 For a general discussion of market power in electricity markets, see Stoft (2002), Borenstein (2002), Borenstein and Bushnell (1999) and Newbery (1995).

7 From a welfare perspective, redistribution of consumer and producer surplus is not obviously undesirable, but deadweight loss is. The distributional effects of the exercise of market power are an important issue in competition law and policy. For a review of recent developments in the Canadian context, see Trebilcock (2004).

As a result, in most jurisdictions with deregulated electricity markets, dedicated regulatory agencies monitor the markets for breaches of market rules, the exercise of market power and other anti-competitive activities. Where generation is particularly concentrated, regulators may require dominant generators to sell certain assets, enter into long-term supply contracts at certain prices,[8] or impose agreements under which revenues above a certain level are clawed back.[9]

Increased integration of markets can reduce a generator's potential market power by increasing the size of the geographic market.[10] Market power is closely related to market share, so increasing the size of the market in which a generator participates effectively reduces that generator's market share and, hence, its potential market power. If a generator attempted to withhold generation assets in order to increase prices, it would only succeed in giving other generators in other regions an incentive to increase their output. This disciplining effect is limited, however, by transaction costs that may prevent more distant generators from exporting electricity to regions where a local generator is attempting to exercise market power. Thus, in addition to giving a direct benefit to importers and exporters, a reduction in transaction costs benefits other market participants, and particularly consumers, by making the market more competitive.

Regions with competitive electricity markets, however, may be cautious about integration with markets where generation is heavily concentrated. Integration may mitigate market power within a concentrated market, but if a more competitive market is integrated with a highly concentrated market, the dominant generators in the highly concentrated market may still retain some potential market power in the combined market. Consumers in the formerly more competitive regional market may thus pay higher prices due to the exercise of market power. In such cases, greater integration may need to be accompanied by structural remedies, such as forced divestiture of assets.

Reduced Costs for Ensuring Reliability

Greater market integration also raises the possibility of reducing reliability costs. In order to maintain the stability of electricity grids, system operators must ensure there is reserve generation capacity that can produce electricity in the event of unplanned outages or transmission failures. Under reliability standards, each system operator must have enough reserves available to meet certain defined contingencies. System operators procure reserves, as well as other ancillary services, either by contract or in a separate market. The cost of these ancillary services is then recovered by passing it on to consumers. It is unlikely, however, that two neighbouring systems would be forced to call upon their reserves at the

8 Alberta, for example, required the three dominant private generators to sell the output of some of their units under long-term Power Purchase Agreements.

9 This was the approach in Ontario during the restructuring of Ontario Hydro (Trebilcock and Hrab 2005).

10 This is subject to transmission constraints. Even if transaction costs in the market are minimal, factors such as congestion, losses and insufficient transmission capacity may prevent generators in other regions from disciplining the exercise of market power by local generators.

same time. Thus, greater integration of markets can allow neighbouring regions to share a smaller total amount of reserves than they would procure individually, reducing the reliability costs that are ultimately borne by electricity consumers (LECG 2001).

Critics of integration have suggested, particularly since the August 2003 blackout in the northeastern United States and Ontario, that greater market integration will leave communities dependent on reliability practices and policies in foreign jurisdictions. They claim that a failure in neighbouring systems to adhere to reliability standards will result in the "import" of blackouts and other system problems. In August 2004, for example, the Ontario minister of energy, Dwight Duncan, suggested that Canada should lessen its dependence on electricity imports from the United States (see Spears 2004). In particular, he noted the lack of mandatory reliability standards in the United States.

Contrary to this claim, greater integration actually enhances, rather than lessens, reliability. First, neighbouring systems provide insurance for unplanned contingencies. It is a basic principle of power systems that if generation falls below load within a control area, power will be drawn from all other connected areas. This gives the system operators time to react to unexpected outages and rapid rises in load by bringing their reserves online. Without this ability to draw on neighbouring systems, a major outage might result in a system collapse or require system operators to cut electricity supply to some consumers.[11] Second, as discussed above, by allowing the sharing of reserves with neighbouring systems, integration can ensure reliability at a lower cost. Even so, reliability practices in neighbouring jurisdictions can be a source of concern, as the 2003 blackout demonstrated. The proper approach, however, is to encourage or require system operators and regulatory authorities to devise, implement and enforce common reliability standards.

Improved Price Signals For Investment and Consumption

One of the motivations for creating wholesale markets for electricity is to provide accurate price signals to potential investors in generation and to consumers of electricity. On the supply side, the existence of accurate price signals facilitates the participation of private actors in generation investment. This transfers the risk of investment away from taxpayers, who bore some or all of the risk of poor planning and bad project management when integrated utilities were publicly owned or publicly regulated.[12] On the demand side, wholesale markets ration electricity to those consumers who value consumption more than the cost of generation, thereby increasing efficiency. If market prices do not reflect the marginal cost of generation, this may lead to over- or under-consumption, which

11 An involuntary load curtailment (shedding load) is typically the last measure taken by a system operator to avoid a system collapse. Besides calling on reserves, system operators can reduce voltages or request voluntary curtailments by large consumers to reduce system load in the event of an unexpected contingency.

12 This was particularly the case in Ontario. See Trebilcock and Daniels (2000) and Trebilcock and Hrab (2005).

reduces allocative efficiency in the economy and distorts investment incentives in sectors that consume electricity.

Wholesale electricity markets will only provide efficient signals for investment and consumption if prices accurately reflect the true marginal cost of generation, transmission and congestion. Prices can be distorted due to the exercise of market power, transaction costs associated with trading across market boundaries, regulatory price caps, incomplete representation of consumer demand, or discretionary behaviour by the system operator. If prices are distorted by these factors this will affect investment, as well as creating inefficiencies in the wholesale market (Joskow and Tirole 2003). Greater market integration improves these investment and consumption signals by reducing some of these distortions; namely, the impact of market power and transaction costs.

In practice, however, the potential benefit of greater market integration in this respect may be overwhelmed by other factors. With respect to consumption, if retail prices are fixed, or if consumers do not otherwise have an incentive to adjust consumption depending on price, then a reduction in the distortions in the wholesale market may not significantly enhance the efficiency of consumption. With respect to generation, a number of factors can lead to under investment. They include regulatory price caps, imperfect information on the part of potential investors, uncertainty about future regulatory changes, regulatory restrictions on investment, and risk aversion on the part of investors (de Vries and Hakvoort 2004). Institutional arrangements may also result in outcomes where neither transmission owners nor the system operator have an incentive to manage congestion. The latter entails influencing the behaviour of generators and loads and managing the availability of transmission in order to reduce congestion (Henney 2002). In other words, although congestion may create significant costs for all market participants, the market design may not provide sufficient incentives for parties to reduce congestion, distorting prices and thus investment incentives.[13]

While greater integration does not provide a complete answer to the issue of attracting efficient investment in generation, it may reduce the need to depend on older, less efficient local generation capacity, where investment incentives have been distorted and investment in generation has been suboptimal. This may limit potential price increases, reduce the need to operate inefficient or polluting generation units, and maintain reliability in circumstances where there is insufficient local generation capacity. Eventually, if it is economical to do so, investment in more efficient local generation will displace imports. This also allows regions to deal with potential supply problems without the need for government intervention, as such intervention has the potential to depress incentives for private investment in generation and expose taxpayers to the same risks and costs that the introduction of electricity markets was intended to reduce.

13 Although some market participants may be able to reduce congestion by adjusting their behaviour, they may not have an incentive to do so unless they are compensated for the cost of the change of behaviour. Unless the system operator (or some other party) has the authority to compensate market participants for changing their behaviour to manage congestion, then congestion costs may be excessive. In certain cases, some market participants may also have an incentive to create congestion in order to increase prices in certain locations, but market surveillance bodies would likely not look kindly upon such strategies.

Addressing Environmental and Health Concerns: Some critics suggest that greater integration will create incentives for private actors to invest in increased generation and transmission capacity to facilitate electricity exports (Cohen 2003). They raise the spectre of hydro or nuclear mega-projects, which may degrade the environment or expose the population to long-term health risks. They also point to the environmental damage inflicted by the construction of increased transmission capacity.

But if one accepts this argument, then self-interested regions should nonetheless pursue greater market integration in order to facilitate electricity imports from other regions, as this effectively shifts any environmental degradation associated with electricity generation to other regions.

As well, even under greater market integration, regional requirements regarding sites and environmental regulations would still constrain private investors. In fact, greater market integration may give regions greater scope for pursuing environmental and health objectives. If a region wishes to impose more restrictive conditions on generation investment, then this can be done without sacrificing reliability or adequacy, as electricity can be imported from other regions with different policy preferences.

Furthermore, if the concern is the long-term health and environmental impact of additional generation and transmission investment, the proper approach is to ensure that the owners internalize all of the costs of generation and transmission. This ensures that inefficient and polluting generators will be priced out of a more competitive integrated market.

Finally, a larger integrated regional market may facilitate the development of environmentally friendly generation technologies such as wind and solar power. Customers in other regions may be willing to pay a higher price for "green" electricity, and these technologies can be used to complement other generation types, such as pumped storage hydro units, to generate electricity more efficiently.[14]

A related concern is that greater integration with regions in other countries may result in dependence on electricity generated using technologies that are not subject to the same environmental standards as in the importing country. In a speech in November 2004, Ontario minister of energy Dwight Duncan said, "We simply cannot afford to continue to look to the south to import electricity from [regions that] rely on dirty coal fired generation" (Duncan 2004). He argued that before Canada could engage the United States on environmental issues associated with electricity generation, "we must get our own house in order" by taking a national approach to electricity issues; relying more on hydroelectric generation in Ontario, Quebec and Manitoba; and becoming more "self-sufficient" in electricity generation.

The concern about reliance on electricity generated by "dirty" coal in the United States appears to be twofold. First, as integration could increase demand

14 Generation technologies such as wind and solar power are referred to as intermittent generation, since they can only generate electricity under certain conditions. However, electricity generated by intermittent technologies during off-peak hours can be used to pump water in storage hydro units, which can release it to generate electricity during peak periods. Thus, complementary use of pumped storage hydro and intermittent generation can result in more efficient use of resources.

for electricity generated using coal, and hence offer opportunities for investment in coal-fired generation, it could weaken incentives for the United States to reduce greenhouse gas emissions or otherwise move away from fossil-fuel fired technologies. In addition, it could undermine perceptions of Canada's stated commitment to reducing carbon dioxide emissions, as it could be said that Canada is simply exporting the problem of greenhouse gas emissions to the United States, which has refused to join the Kyoto Accord. Second, importation of electricity generated using coal could impose environmental externalities on Ontarians. In particular, any presumed contribution to global warming through greater use of coal-fired generation would also affect Ontarians, and indeed, all Canadians.

The concern that greater regional integration will have adverse effects on the Canadian environment or result in unfair competition with Canadian generators is overstated, however, for several reasons. For one thing, most of the adverse environmental effects of using coal to generate electricity are local, and Canada should have no concern about whether, or to what extent, the US chooses policies that impose burdens on its own citizens (Revesz, 2001). For another thing, with the addition of its sulphur dioxide emissions ceiling, the US is increasingly requiring its existing coal-burning generators to internalize most of their environmental costs (Black and Pierce, 1993). Moreover, US air quality rules require new coal-fired generators to internalize virtually all of their environmental costs, so increased demand from Canadian consumers will not produce large adverse effects on the Canadian environment as a result of newly constructed, high-polluting, coal-fired generating plants in the US.

This leaves only the concern about the potential effects of the US decision not to participate in the Kyoto Accord. That is a legitimate concern, but it is much broader than the US role in an integrated North American electricity market. It applies to markets for all goods and services that account for emissions of carbon dioxide no matter where the good or service has its origin. Thus, for instance, it is a concern that applies as much to Canadian imports of goods from India and China — other countries that have refused to participate in Kyoto — as to Canadian imports of electricity from the US. The arguable need for increased global efforts to reduce anthropogenic global warming is far too broad a project to pursue as part of any effort to increase regional integration of the North American electricity market.

Addressing the Concerns of National Policy Proponents: Often, calls for a national electricity policy accompany criticisms of greater regional market integration. Under this proposal, integration would occur only within national borders and electricity imports and exports would be curtailed, regardless of countervailing economic or technical considerations. Advocates of such a policy suggest that it would result in a more equal distribution of wealth, reconcile the different electricity policies pursued by different regions within the country, ensure that foreign authorities do not control domestic electricity policy, and unify the country in the same manner as other "national" projects such as national highways and rail links (Orchard 2003).

Assuming that a national electricity policy could achieve all of these claims, it is far from clear that it is the most efficient means of doing so. Electricity policy is unlikely to be the most efficient way of realizing distributional goals. If the

concern is to ensure that less well-off regions are able to share in the benefits obtained by other, wealthier regions, then it seems that it would be more efficient to transfer wealth between regions, as Canada does under equalization policies, rather than electricity.

Moreover, there is no clear advantage to a single national electricity policy rather than several regional policies. Different regions within a country may choose different institutions and different generation technologies based on local preferences and endowments.

While greater market integration does imply that institutions and policies related to the electricity sector may have to be coordinated with those in foreign jurisdictions, this is not tantamount to a complete abdication of control over electricity policy. Although national unity considerations are not to be dismissed lightly, it is questionable whether electricity policy is an appropriate means of promoting national values.

Factors Affecting the Optimal Size and Configuration of Regional Electricity Markets: The geographic boundaries of most electricity systems and markets tend to coincide with internal and national political boundaries, which reflects the history of regulation of the electricity sector. These boundaries do not necessarily coincide with the boundaries of optimal market areas, which are dictated by technical and economic factors rather than political factors. To maximize the potential benefits of market integration, the size and configuration of regional electricity markets should be determined by the costs and benefits of greater integration, rather than non-economic and non-technical factors.

In economic terms, a market has reached its optimal geographic size when the marginal benefit of expanding the geographic size of the market is equal to the marginal cost of expansion. The benefits, as discussed above, consist of the gains from trade and from the more efficient investment that results when congestion is relieved, transaction costs are reduced and market power is mitigated. The costs of expansion, on the other hand, include the cost of increasing transmission capacity between regions and the cost of improving coordination between system operators and market participants. In most cases, the cost of expanding transmission capacity between regions will be the limiting factor. This will be determined largely by distance, which influences the cost of transmission investment and the cost imposed by transmission losses. Thus, if the potential benefits of increasing transmission capacity between two regions are less than the costs of such an investment, then it is not economical to expand the market to include both regions.

In practice, the quantification of benefits will be a critical issue in evaluating any proposed expansion of electricity markets. Many of the benefits described above, such as improved signals for investment and consumption, are difficult to quantify and attribute specifically to integration. Furthermore, market integration must be considered against potentially less costly alternatives, such as increasing generation, transmission or conservation within the region. Thus, it is clear that larger markets are not always more efficient markets. As benefits may decrease as market size increases, the costs of integration and the availability of alternatives will ultimately limit the size to which a given market can be efficiently expanded.

Part II: The Preconditions to Effective Regional Market Integration

Efforts to restructure electricity markets in order to allow market forces to play a greater governance role have been ongoing in many parts of the world for nearly 20 years. Over that period of time, a broad consensus has evolved with respect to the general preconditions for an effective restructuring of a regional wholesale market. (Joskow, 2003; Pierce, 2005a). Those preconditions include:

(i) vertical separation of functions that are potentially susceptible to trade in an unregulated competitive market (generation and sales) from functions that must remain regulated as natural monopolies (transmission and distribution);
(ii) horizontal integration of transmission and network operations to create the largest wholesale market that is consistent with the efficient electrical boundaries of an integrated grid, as well as designation of a supra-jurisdictional body to co-ordinate at least some cross-border integration functions internally or internationally;
(iii) provision of nondiscriminatory access to the grid and the network and a single charge for access to the entire network rather than "pancaking" of transmission charges imposed by separate owners of transmission assets.
(iv) creation of wholesale spot energy markets that balance supply and demand on a real-time basis and that are capable of responding quickly to unplanned outages of generation or transmission facilities;
(v) creation of mechanisms through which consumers confront, and can respond to, changes in supply and demand conditions;
(vi) creation of a mechanism to allocate scarce transmission capacity; and
(vii) creation of mechanisms that are effective in inducing or requiring adequate investment in new or expanded transmission capacity.

We begin by explaining the significance of each of the seven preconditions for a successful restructuring and briefly examine the reasons why these conditions have not been fully satisfied in various jurisdictions.

Vertical Separation of Functions

Vertical separation of functions is a precondition for a successful restructuring because it eliminates the ability of, and incentive for, owners of transmission lines and other natural monopoly facilities to favor their own generation and to handicap their competitors in the generation and sales markets. Ideally, vertical separation should be accomplished at the ownership level, i.e., transmission and distribution assets should be owned by entities that do not also own generating assets or participate in other ways in the competitive sales market. As a second-best, separation can be accomplished functionally by allowing common ownership of facilities but enforcing prohibitions against inter-affiliate favouritism, although it is difficult to enforce such prohibitions.

Horizontal Integration of Transmission and Network Operations

Horizontal integration of transmission and network operations across an area that can support a large wholesale market and the creation of a supra-jurisdictional body to co-ordinate some cross-border integration functions are important preconditions to a successful restructuring for two reasons. First, through application of Kirschoff's law, electricity flows across an integrated grid in inverse proportion to the impedance on each line (Hogan 1993). As a result, any change in conditions on one part of an integrated grid instantaneously affects the operation of all other parts of the grid. Thus, for instance, a transmission line outage in Ohio can have severe adverse effects on flows of electricity in Toronto and New York City. In this situation, ideally a single entity should control the operation of each integrated grid to maximize reliability of service by coordinating the necessarily instantaneous responses to each change in conditions.

Second, wholesale electricity markets must be large enough to support a structurally competitive generation and sales market. To perform well, a wholesale electricity market must have a relatively large number of participants, none of which has the ability to engage in profitable unilateral withholding of otherwise available capacity from the market. Because electricity markets are characterized by low short-term price elasticity of demand and, in some recurring market conditions, by low short-term price elasticity of supply, they are unusually vulnerable to exercises of market power. Only a large wholesale market is capable of supporting competition among a sufficiently large number of efficiently sized generating and marketing entities to reduce the risk of exercises of market power to a tolerable level.

Non-Discriminatory Access to the Grid

An effectively functioning, competitive wholesale market requires assured non-discriminatory access to the grid. Some institution must take responsibility for policing the conditions for access to the grid to ensure that every buyer and seller has non-discriminatory access. This is a relatively easy task to perform when transmission assets are not owned by firms that also own generating assets or otherwise participate in wholesale markets because the owners of the transmission facilities have no incentive to discriminate among market participants. It is far more difficult to perform that function effectively when owners of transmission facilities also participate in the wholesale market as sellers or buyers. It is also important to avoid the pancaking of transmission charges by separate owners of portions of an integrated transmission grid. The price of transmission should be based on marginal cost, and the price should be unrelated to the number of firms that own portions of the transmission grid.

Existence of Effectively Functioning Spot Market

An effectively functioning spot market for electricity that is capable of responding instantly to constantly changing supply and demand is essential. It determines the

extraordinarily dynamic real-time price of electricity and allocates electricity among competing buyers. One of the important functions of such a spot market is to provide the bases on which market participants can structure their long-term relationships. Thus, for instance, buyers and sellers must remain free to obtain price or supply stability by entering into long-term physical or financial contracts at terms that vary from the constantly changing price of electricity on the inherently volatile spot market. However, buyers and sellers cannot effectively structure and implement their long-term relationships in the absence of a spot market, and a spot market is essential to allow the market to clear at all times.

Consumers' Incentive and Ability to Respond to Price

A wholesale market cannot be effective in limiting sellers' ability to exercise market power, by withholding available supplies, unless consumers are given the incentive and the opportunity to respond to changes in market conditions. They do this by increasing or decreasing the quantity of electricity they consume (US Government Accountability Office 2004; Ruff 2002). Thus, an effectively functioning wholesale market depends critically on the implementation of mechanisms that maximize the correspondence between the constantly changing market conditions and the price consumers confront.

Ideally, each consumer should confront the constantly changing spot market price, but that ideal is not attainable at present because most small consumers do not have interval meters. At a minimum, all large consumers should confront the real-time price of electricity, and regulators should refrain from imposing retail price caps that insulate small consumers from the effects of increases in relative scarcity. Such price caps are a prescription for disaster, as California discovered in 2000.

If consumers are insulated from retail price increases when supply becomes relatively scarce, even sellers with only a modest share of the market have a powerful incentive to withhold available supplies, thereby producing a rapid and potentially catastrophic price spiral (Pierce, 2003). Ordinarily, a firm that sells in a structurally competitive market cannot profitably engage in the unilateral withholding of capacity because the resulting price increase will cause consumers to reduce the quantity they consume. This leads to a reduction in the firm's net revenues because the fall in revenues caused by selling fewer units exceeds the increase attributable to selling the units at a higher price.

That powerful check on a firm's ability to exercise market power is eliminated if consumers do not directly face the price increase and therefore do not reduce the quantity they purchase. In that situation, even a firm with a small market can engage in profitable withholding of capacity from a wholesale market. By withholding capacity, the firm creates an increase in the wholesale price it receives per unit without experiencing any offsetting reduction in revenues attributable to a reduction in the number of units the firm sells.

Creation of a Mechanism for Allocating Scarce Transmission Capacity

No transmission grid is capable of accommodating all of the transactions that buyers and sellers want to implement at all times. Some transmission capacity constraints are inevitable in a well-designed wholesale market. Because of Kirschoff's law, a change in conditions at one point on a grid has the potential to create capacity constraints at other points on the grid, sometimes hundreds of miles away.

Since conditions on any grid change constantly, the location and magnitude of capacity constraints are highly variable. Any time a capacity constraint renders it impossible to accommodate all of the transactions that buyers and sellers want to implement, there must be some mechanism to ration scarce transmission capacity among competing users. The most efficient means of rationing scarce capacity is through the use of a market mechanism.

The mechanism that is best suited to application in this context is referred to as locational marginal cost pricing, or LMP. It uses a software algorithm to implement a continuous series of auctions through which scarce transmission capacity is priced and allocated to the user who places the highest value on the capacity (Hogan, 1993). There are a variety of alternative means of allocating scarce transmission capacity. Some of them rely on crude approximations of market price and some of them substitute administrative allocation of scarce capacity for market-based allocation of scarce capacity. However, none of those mechanisms is as reliable and efficient as LMP (Hogan 1997; Perez-Arriaga & Olmos 2004; Pierce 2005a). Nevertheless, it is important to recognize that LMP alone may not ensure adequate investment in transmission capacity. Regulators may need to take other actions to create incentives for adequate investment in transmission capacity and to minimize regulatory barriers to the expansion of transmission capacity.

Mechanisms that Induce or Require Transmission Investment

A wholesale market will not function efficiently without sufficient transmission capacity. A well-designed market can and must accommodate occasional capacity constraints at some locations, but chronic, widespread, or prolonged capacity constraints are incompatible with an efficiently functioning competitive wholesale market. They have adverse effects that include reducing the effective size of the market and creating conditions, as a result, in which sellers can profitably exercise market power by withholding otherwise available supplies from the market (Hirst 2004).

The Experience in Other Jurisdictions

No jurisdiction currently satisfies all of the preconditions identified above. We have reviewed elsewhere the manner in which the United States, the European Union, the Nordic countries and Australia are attempting to attain these

preconditions and the status of these incomplete restructuring efforts (Pierce, Trebilcock and Thomas, 2005).

Despite the failure of any jurisdiction to fully satisfy all of the preconditions, their experiences are instructive. The obstacles these jurisdictions have encountered are similar to the obstacles that Canada (and any other federal system) must overcome if it chooses to embark on a restructuring initiative. As well, in attempting to implement resructuring plans without first satisfying the basic preconditions for success, they demonstrated the importance of each of the preconditions.

This is a context in which socially beneficial change is difficult to attain and in which a few errors in market design can have devastating consequences, as the debacles in California in 2000 (Sweeney, 2002; Pierce, 2002), and in Ontario in 2002 (Trebilcock and Hrab, 2005; Ruff, 2003) illustrated. Given the size, proximity, and technical integration of the United States and Canadian markets, any socially beneficial restructuring effort in Canada must be designed and implemented in a manner that is compatible with the US system of governance of the electricity market.

Most of the failures to satisfy the preconditions for an effective restructuring are attributable to the inability or unwillingness of government institutions to make the necessary changes in market structure. We identify four possible explanations for the slow progress in reforming electricity industries and markets: First, the persistent influence of the vertically integrated utility model of an electricity supply industry; second, government industrial policy; third, opposition from entrenched interests; and fourth, the transition costs inherent in large-scale integration. We discuss each in turn.

The Vertically Integrated Utility Model: Due to economies of scale and scope in generation, transmission and distribution, the prevalent view in the past was that vertically integrated utilities owned or regulated by the state were the optimal structure for the electricity supply industry. This structure restricted opportunities for contracting between utilities, though there has always been limited electricity trade between regions in North America. This model has been challenged by the introduction of new generation technologies with a lower minimum efficient scale of generation and by developments in economic thinking regarding the optimal structure of the electricity industry.

Government Industrial Policy: Historically, electricity policy has been an element of industrial policy in many jurisdictions. State-owned utilities have been viewed as an instrument for promoting regional economic development by providing low-cost power for industry. Similar considerations have also affected site selection for generation and transmission facilities, as well as the choice of technologies. In Ontario, for example, the decision to construct nuclear generation in the 1970s and 1980s was in part motivated by the prospect of showcasing Canadian technology and selling it abroad. These rationales are increasingly criticized as inducing inefficient investment decisions (Daniels and Trebilcock, 1996).

Opposition from Entrenched Interests: Public choice theory suggests that parties with an interest in maintaining the status quo will resist a transition from local markets to regional ones. The historical market structure of the electricity supply industry,

which is largely the result of the first two factors discussed above, has created sets of interests that will be affected in different ways by any transition to greater regional market integration. Thus, for instance, in some circumstances, some classes of consumers, regulators and public sector unions stand to lose under a transition, whereas other classes of consumers and taxpayers stand to gain. Those who will benefit from greater integration are diffuse, unorganized and may not be fully informed, but those who will lose are concentrated, organized and well-aware of the consequences for their interests. As a result, even though greater market integration may provide a net benefit, those who will be negatively affected will lobby strenuously to resist it (Boyer 2005).

Transition Costs: The transition costs of integrating regional markets are high, so any transition will take time. Integration requires overcoming jurisdictional boundaries and coordinating reforms among multiple actors, particularly recognizing that in more decentralized market-driven electricity systems the optimal configuration and location of generation and transmission facilities may be different from that under a vertically integrated local regime, increasing the risk of stranded assets (and costs). Thus, even if all stakeholders favour integration, the transition may be costly and protracted.

Part III: The Canadian Electricity Market

Electricity trade in Canada is more oriented towards trade with the US than between provinces, although there are exceptions. For example, Quebec imports power from Churchill Falls, Newfoundland and Labrador; meanwhile, almost all of Prince Edward Island's electricity supply comes from New Brunswick and Nova Scotia; and there is significant trade between Alberta and British Columbia. Within Canada, the exporting provinces all have large hydroelectric resources, while the importing provinces all use significant amounts of fossil fuel for electricity generation.

Table 1 below provides a summary of nominal transfer import and export capacities by province. With respect to the largest electricity market in Canada — Ontario — Table 2 below summarizes Ontario's interconnection limits as of 2002.

Transmission Constraints: A recent survey by Navigant Consulting on electricity transmission capacity in Canada (Navigant Consulting 2003) finds that a number of the east-west and north-south transmission interconnections are often operating at full capacity and that capacity limits seriously constrain the ability of provincial electricity systems to export or import electricity. These transmission constraints are particularly binding with respect to power exchanges in the West (between B.C. and the US; Alberta and B.C.); in Central Canada (between Manitoba and Ontario) and eastward. They affect Newfoundland and Labrador's exchanges with Quebec and Ontario; Ontario exchanges with the US; and Nova Scotia's exchanges with New Brunswick and Maine. While a number of potential or proposed investments in new or enhanced transmission interconnection capacity have been mooted to relieve some of these capacity constraints, very few of these are currently proceeding.

Demand Growing Faster than Capacity: A recent evaluation by the TD Bank Financial

Table 1: *Summary of Nominal Transfer Capacities*

Province	Nominal Capacity		Proportion of 2002 Peak Demand	
	Import	Export	Import	Export
	megawatts		*percent*	
British Columbia	3,000	4,350	33	48
Alberta	1,350	1,150	16	13
Saskatchewan	765	840	27	30
Manitoba	1,475	3,000	39	80
Ontario	4,665	4,825	18	19
Quebec	9,440	6,825	27	20
New Brunswick	1,695	2,105	56	70
Nova Scotia	300	350	15	17
Prince Edward Island	200	200	102	102
Newfoundland and Labrador	0	5,200	0	255

Source: Navigant Consulting, 2003.

Table 2: *Ontario's Interconnection Limits*

Interconnection	Flows Out of Ontario (MW)	Flows Into Ontario (MW)
Manitoba	300	375
Minnesota	140	90
Michigan — Winter	1,800-2,200	1,200-1,700
Michigan — Summer	1,700-2,100	700-1,700
New York East	400	400
New York West — Winter	1,000-2,000	1,200-1,500
New York West — Summer	700-1,800	1,000-1,300
Québec South — Winter	760	1,380
Québec South — Summer	740	1,385
Québec North — Summer	95	65
Québec North — Winter	110	84

Source: Navigant Consulting, 2003.

Group of the capacity of Canada's electricity systems to meet future demand (Burleton and Kalevar, 2005) concludes that Canada's electricity picture remains strong overall, but that growth in electricity consumption is now outstripping growth in generation capacity. Since the mid-1990s, demand for power has risen by about 1.5 percent per annum, more than twice the 0.6 percent rate of generation expansion. The increasing supply-demand squeeze has been reflected in a combination of declining exports (down 3.4 percent per year) and rising imports (up 20 percent per year).

Common Threads in Provincial Plans for Action: The TD Bank study notes a number of common threads among various plans for action announced by provincial authorities across the country. These include a push towards increasing trade links in order to take advantage of lower transmission costs, export opportunities and enhanced reliability, with more provinces likely to participate with US-initiated regional transmission operators; at present only Manitoba is formally a party to such a regime, although other provinces are exploring this option. There is also a continuing trend towards regionalization of the electricity market, with north-south trade contributing a growing share of overall provincial electricity generation. Nevertheless, there is also widespread acceptance across Canadian provinces of the need to strengthen east-west connections in order to mitigate the risk arising from possible supply disruptions from the United States. The study also notes that a good part of the solution to eliminating emerging gaps between electricity supply and demand rests in demand-side management. Applying the law of one price as a measure of the completeness of the integration of electricity markets, this study notes major variations in retail electricity prices across Canada. Wide variations in retail electricity prices across Canada and the US are also noted in Boyer 2005.

Constraints to Transmission Development and Investment: The two most important barriers to transmission investment are project economics and market uncertainties, according to a survey by Navigant Consulting Ltd. (2003) of provincial electric utilities, system operators, and government policymakers on the various constraints to transmission development and investment. Economic regulation is identified as the third most important barrier. Approval processes, environmental and social issues, and uncertainty of transmission access and cost were the next most significant barriers. Willing partners, or lack thereof, and multiple jurisdictions were the next tier of impediments. Land acquisition and different forms of regulatory controls were both of average importance.

Untapped Potential: Canada has a large potential for further generation development. Canada's technical hydro power potential, for example, has been estimated at 118,000 MW of capacity by 2025, twice the amount that is currently in operation. Manitoba, Quebec, and Newfoundland and Labrador have the potential for major hydroelectric developments. Such developments would require new interprovincial or international transmission facilities (Rothman, 2005).

There is also the potential for the development of fossil fuel resources. Alberta and British Columbia both have the potential for further development of significant coal-fired generation. Alberta oil sands and heavy oil projects could support significant co-generation development. Nova Scotia's natural gas production could support new gas-fired generation development. Wind farms are

projected to play a more significant role as an alternative source of power in the future. The need for new transmission lines and barriers to the construction of these lines are themselves a barrier to generation development in some cases (Navigant Consulting Ltd., 2003).

In summary, the Canadian electricity market is characterized by an orientation towards trade with the United States, rather than east-west between provinces. Moreover, while the electricity picture is on the whole strong, growth in demand is outstripping growth in generation capacity across the country. Provincial governments are responding with proposals that share several common threads, including a trend toward market regionalization, However, market participants identify constraints to transmission development and investment which pose an obstacle to both new transmission and new generation capacity.

Ontario's Experience:

As the largest electricity market in Canada, Ontario provides a useful focus for assessing whether the seven preconditions to greater market integration exist. First, though, we turn to a brief review of inter-provincial and cross-border trade in electricity in Ontario since it opened its wholesale electricity market to competition in May 2002.

When competition was first introduced, the average hourly wholesale price was 3.01¢ per kWh (all prices stated are the weighted average for the month). Prices began to increase rapidly as the abnormally hot summer progressed. The weighted average wholesale price for the first year of the open market was 6.2¢ per kWh. The Independent Electricity System Operator (IESO) made 38 emergency input purchases during the summer of 2002 to maintain system reliability.

The large amount of imports strained transmission intertie capacity with other jurisdictions. The province's interties with Manitoba, Quebec, New York, Minnesota and Michigan all experienced varying degrees of congestion during the summer of 2002. The province was importing the maximum amount of electricity — roughly 4,000 megawatts — that the transmission system could physically accommodate. Again, in the abnormally hot summer of 2005, substantial imports, mostly from the US, were required to avoid brownouts or blackouts.

Ontario's interdependence with neighbouring markets is clear. But how closely does Ontario satisfy the preconditions to effective integration of regional electricity markets?

Ontario has made some progress with regard to the first precondition, vertical integration. Prior to market opening, the old provincially owned, vertically integrated electricity utility, Ontario Hydro, was split into separate generation and transmission entities (Ontario Power Generation Inc. and Hydro One Inc.), albeit still government-owned but separately managed.

Precondition two, horizontal integration, is the most institutionally problematic and contentious of the seven preconditions. We return to it below when we consider a role for a supra-jurisdictional body, the National Energy Board, in promoting horizontal integration.

With respect to the third precondition, non-discriminatory access to the transmission network has now been largely achieved with the elimination of most

forms of pancaking of transmission rates on imports or exports across interconnected transmission systems. Ontario still charges $1.00 per MWh on exports but is negotiating with the New York ISO to drop this charge on a reciprocal basis. Furthermore, as to effective regulation of network access charges, these are determined within Ontario by the Ontario Energy Board on a non-discriminatory basis.

With respect to the fourth precondition a wholesale spot market, Ontario operates its own wholesale spot market, although imports are contracted for outside the spot market. Senior officials with IESO believe that significant divergences in spot prices in the wholesale market between domestically produced electricity and imports are increasingly uncommon and can largely be eliminated by harmonizing market rules with neighbouring ISOs.

With respect to precondition five, demand-side responsiveness to electricity prices, the Ontario Energy Board, at the request of the Ministry of Energy, has developed a plan for the installation of 800,000 interval meters by December 2007 and the installation of such meters for all consumers by December 2010 (Ontario Energy Board, 2005a, 2005b). Retail prices are subject to regulation by the Ontario Energy Board, which has recently announced new regulated retail prices for residential consumers that use less than 250,000 kWh per year and consumers in the municipal, community, school and hospital sectors. The price of electricity for eligible consumers (the pure energy charge) will be 5¢ per kWh for the first 750 kWh they use each month and 5.8¢ per kWh for electricity used per month above this amount with some provision for peak load pricing (Ontario Energy Board, 2005c, 2005d; Faruqui and George, 2005).

With respect to precondition six, the allocation of interconnection capacity, financial transmission rights across each of the interconnections are auctioned off by the IESO.

Regarding the development of efficient mechanisms for inducing or mandating investments in new transmission capacity in the system (precondition seven) locational marginal pricing of transmission capacity in theory should indicate where new transmission or generation investments are required. No Canadian province is currently committed to introducing LMP, and evidence from the US suggests caution in assuming that enhancements in transmission capacity, including transmission interconnections, can be purely market driven. Within Ontario, the IESO develops long-term forecasts of required enhancements in transmission capacity (IMO, 2004a; IMO, 2004b), as does Hydro One, the transmission grid owner (Hydro One, 2004). The Ontario Energy Board can order Hydro One to undertake specified investments and incorporate them in its rate base. Pursuant to the *Ontario Electricity Restructuring Act 2004*, a new government agency, the Ontario Power Authority (OPA), has been created with responsibility for provincial electricity capacity planning. Increases in transmission capacity on a regional basis require coordinated planning efforts with neighbouring ISOs, and at present few common initiatives have been undertaken.

Attempts by the governments of Ontario and Quebec to negotiate increased interconnection capacity have been at least temporarily derailed by a decision of the Quebec regulatory authority denying Hydro Quebec the ability to include the costs of this investment in its rate base. Ontario and Quebec are non-

synchronously connected, currently requiring the isolation of generators in Quebec from the Quebec grid to service the Ontario market.

Returning to precondition two, horizontal integration, a striking difference between Canada and the US is the prominent role played by the Federal Energy Regulatory Commission (FERC) in the US in promoting regionally integrated electricity markets relative to the National Energy Board in Canada. In the US, FERC has promoted the emergence of two very large ISOs — the Midwest ISO and the PJM ISO — but seems to have come to accept that these can co-exist with smaller ISOs such as Ontario, New England, and New York.

There is also a means of addressing externalities or congestion caused by exercise of the dispatch function by decentralized or non-integrated ISOs. Currently, jurisdictions that are negatively affected by dispatch decisions in other jurisdictions can call for the suspension of the transaction. However, discussions are underway among neighbouring ISOs to develop ways to avoid suspending entire transactions and instead adjust local dispatch to accommodate out-of-jurisdiction transactions, where feasible. There would be compensation arrangements for local losses from such adjustments. However, no thought is currently being given in Ontario to joining a larger regional ISO. Officials within the IESO consider that there are no large savings foregone from staying out, and there are significant benefits to retaining the ability to deal with local transmission requirements. With respect to the setting of common system reliability and security standards, the North American Electric Reliability Council (NERC) promulgates voluntary standards and FERC in the US has adopted good utility standards which, while not carrying financial sanctions by FERC, permit regional ISOs to levy penalties for violations.

While there is clear federal jurisdiction in Canada over international and interprovincial power trades, section 92A (1) (c) of the *Constitution Act of 1867* gives the provinces exclusive jurisdiction over "the development, conservation and management of sites and facilities in the province for the generation and production of electrical energy."

Thus, from both legal and political perspectives, it may be difficult to conceive of a role for the National Energy Board as large as FERC's in the foreseeable future with regard to promoting broader regional integration of electricity markets either within Canada or between Canada and the US. These issues will thus remain largely within the remit of provincial and state utilities, regulators, and ISOs. Nevertheless, from Ontario's perspective, better integration with adjacent markets to enhance access to hydroelectric supplies seems an important policy priority, given such factors as the commitment to retire coal-fired generators in the near future, nuclear power plants nearing the end of their useful life, and increasing concerns over the environmental effects of fossil-fuel fired generation. Those adjacent markets, of course, include the North East of the US, but also Manitoba, Quebec, and through Quebec, Labrador.

Recent proposals by provincial governments to promote an east-west transmission grid across Canada ignore certain realities. Achieving economies of scale for investments in generation and transmission facilities requires reasonable proximity to large population densities. Long distances and low population densities in many parts of Canada, with much of the population clustered close to

the US border, suggest that north-south trade will always remain important and that within Canada (as in the US) stronger regional rather than national markets are likely to be efficient. To this end, comparative experience suggests that these markets will not emerge in the absence of supra-jurisdictional agencies to co-ordinate at least some horizontal integration functions.

Despite doubts about the extent of federal jurisdiction in these matters, it is worth noting that telecommunications regulation in Canada is now a matter of exclusively federal jurisdiction (the CRTC), as is the construction and regulation of interprovincial and cross-border natural gas and oil pipelines (the NEB). At a minimum, federal jurisdiction over inter-provincial and international trade in electricity should be asserted through the National Energy Board to ensure (i) non-discriminatory access by out-of-province or out-of-country generators to transmission facilities within a province and (ii) that approval of proposed investments in enhanced interconnection capacity and cross-border transmission facilities falls within exclusive federal jurisdiction.

Pursuant to this mandate, the NEB should evaluate the economic feasibility of various cross-border transmission facility enhancements (which obviously we have not attempted to do), set out the regulatory framework to govern their operation, invite competitive proposals for their construction, and, at the limit, mandate their construction on economically prudent terms. This would leave co-ordination of dispatch, spot market, settlement functions, and reliability standards initially to provincial agencies, in the hope that a stronger federal presence would induce the emergence, over time, of cross-jurisdictional co-ordinating mechanisms or agencies.

Conclusion

Nations and multinational regions can attain large net benefits — measured in billions of dollars per year — by increasing the degree and extent of integration of their electricity markets. We have identifed seven preconditions for the creation of an effectively functioning regional electricity market and analyzed the present conditions in the Canadian market to determine the extent to which that market now satisfies the preconditions for a successful restructuring of a regional market.

Canada can enhance the performance of its electricity market by increasing the size of its market and by increasing the degree of integration, both within the Canadian market and between the Canadian market and the adjacent, electrically connected United States market. Because of geographic and demographic factors, we conclude that increased north-south integration is at least as important as increased east-west integration. We urge the National Energy Board to begin to take a much more active role in the process of increasing the degree of regional integration, at least within the Canadian electricity market.

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